Dredging Research

Vol 2, No. 3 Information from U.S. Army Engineer Research and Development Center Sept. 1999

Dredging research impacts dredging operations and management at Norfolk District

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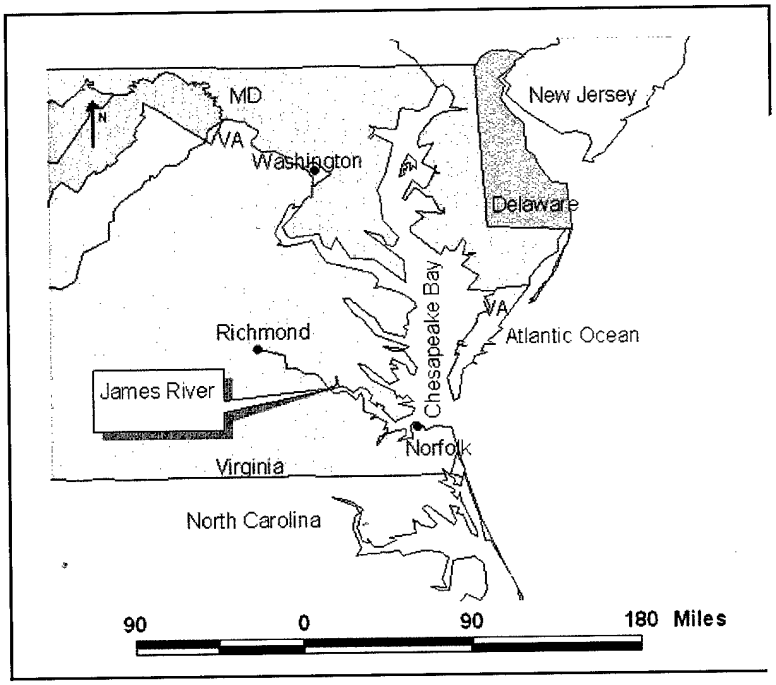
For many years, dredging research results have contributed significantly to the successful design of navigation projects in the Norfolk District Corps of Engineers. This type of research, and how it has been used, has evolved over the years.

Before World War II, Norfolk District engineers planned, engineered, and constructed many navigation projects without the help of sophisticated research. They relied on and learned through experience, mentoring younger engineers through several generations. The engineering designs of that period were really quite remarkable and sophisticated, considering the designers' limited access to information about new technology. District staff designed deep draft channels, selected placement areas, built structures, and developed wildlife habitats. Many of the innovative applications from that era are still in use today and are recognized as being well ahead of their time.

From an historic perspective, research results were available in the past, but access for the most part was limited to publications. Engineers used the published research if the information applied to their project. But often, the research topics chosen were not pertinent to the ultimate project. The funding organization often dictated the type of research conducted, resulting in either too general or too esoteric information for general use. In addition, results were not easily adaptable to different areas of the country or to projects with special needs.



James River

In this issue . . .

The major driving factor that propelled dredging research to the forefront was the concern for the environment. Environmental laws affecting dredging operations started in the late 1960s and early 1970s, posing a number of specific questions that needed to be investigated. In response to the needs, the Dredged Material Research Program (DMRP) was formed in the early 1970s. Tasked with addressing dredging environmental concerns and providing research results for national application, some of the testing and analysis under DMRP occurred in academia. This approach resulted in promotion of research goals, some of which did not necessarily improve the Corps' dredging mission.

One DMRP project in the Norfolk District was a marsh creation project on an island in the James River. It was a successful pilot project monitored by ERDC scientists and engineers who used research funds. Although the project did not meet a direct need of the Norfolk District, this DMRP research project served as a demonstration for future Corps projects.

Research in the past addressed major engineering and environmental concerns whenever funding was available. For example, the Norfolk District was involved in a deepening project on the James River. The James River Federal navigation project was authorized in 1884 to a depth of 35 feet, but when it was constructed, only a 25-foot depth was needed.

During the late 1950s and early 1960s, Norfolk District engineers studied a major deepening of the 86-mile channel to the authorized 35-foot depth. The deepening raised environmental concerns about saltwater intrusion and its effects on seed oyster beds in the river. Some of the most productive seed oyster grounds in Virginia are located at the mouth of the James River.

To answer these concerns, the Norfolk District funded construction of a large physical model capable of simulating the saltwater flow in the river. The project was located at the Waterways Experiment Station. The model successfully addressed the environmental concerns and was also used later to respond to sediment fate questions. Although costs were enormous, the research results were impressive.

Current Research Approach

In search of a fiscally efficient method for conducting research, managers and researchers began to focus on input from the districts' engineers for products and tools that can help solve the districts' daily problems. This approach was in addition to the major projects that require substantial funding. As innnovations continue to be developed in the field, by the field engineers themselves, and are shared in informal ways, district personnel also have the opportunity to provide input into the nature and kind of research that is conducted for optimal problem solving. As a result, more research results are quickly incorporated into the daily mission, paying faster and greater dividends. Research is tightly focused on the highest priority mission items at field locations.

Some examples of research that has greatly benefitted the Norfolk District has applications to other projects, and has saved millions of dollars, are as follows:

- **Craney Island Management Plan** - A number of ERDC-sponsored research programs used engineering tools to extend the life of this 2500-acre upland containment facility.
- **Technological Innovations** - Dredging Research Program (DRP) projects, including advanced acoustical and digitized data collection, global positioning system, silent inspector, and strip drains are currently being used at the district level and have saved millions of dollars. In addition, the telescoping weir, invented by Norfolk District and ERDC engineers, has been highly successful in maximizing placement site capacity and improving water quality.
- **Information Technology Exchange and Sediment Fate** - These ongoing DOER programs are already benefitting districts and resulting in shared technology.

In summary, the Norfolk District has greatly improved its dredging and dredged material placement programs with the help of dredging research conducted over the last 20 years. Some of the results include:

- Long-term placement of dredged material at more than 100 sites
- Beneficial uses of dredged material at more than 40 sites
- High technology application such as automated hydro systems, side scan sonar, and digitized data

Future Research Focus

What will the future bring as it relates to research? The Norfolk District is trying to position itself through advanced technology to solve mission-related challenges. Finding long-term placement sites that incorporate beneficial uses of dredged material and analyzing sediment fate will continue to be areas that receive high priority consideration. An upcoming research effort with ERDC laboratories and state agencies will involve the use of Acoustic Doppler Current Profiler surveys, automated hydro surveys, and sediment fate knowledge to study the response of dredging plumes on anadromous fish on the James River. The results will show whether there is truly a need for seasonal dredging restrictions. If the capability to predict dredging windows can be demonstrated, this research will have national applications.

Most research efforts also need reliable past data to solve project-related problems. A promising development in this effort is the use of Geographic Information Systems (GIS). Norfolk District is committed to placing much

of its past data and that of others into a GIS. This, combined with tools developed through ERDC laboratories and other research, will be used by the Norfolk District to build and maintain future projects in ways that are more economically and environmentally acceptable.

Additional information is available from Elizabeth (Betty) G. Waring, Civil/Environmental Engineer, Waterways and Ports Branch, e-mail: *elizabeth.g.waring@usace.army.mil*, or Ronald G. Vann, Chief, Waterways and Ports Branch, e-mail: *ronald.g.vann@usace.army.mil*. Both are with the Norfolk District Corps of Engineers.

TELESCOPING WEIRS FOR DECANTATION OF WATER FROM DREDGED MATERIAL CONTAINMENT FACILITIES

The telescoping weir was conceived and developed by Jack Fowler, Ronald G. Vann, and T.D. Woodward during a joint research effort by the ERDC Waterways Experiment Station, Vicksburg, Mississippi, and funded by the Norfolk District Corps of Engineers. The concept was placed on mechanical drawings in 1986, a prototype model was constructed at WES in 1992, and the first full-size prototype telescoping weir was constructed and installed at Craney Island Confined Dredged Material Facility (CDF) in 1996.

The telescoping weir is an innovative structure that has the ability to closely control the environmental water quality during decantation and drainage of water from the dredged material surface of CDF's. The telescoping weir consists of a set of vertically nested cylinders set on end with one cylinder within the other. The bottom cylinder is fixed to a foundation that is anchored to the bottom of the CDF and connected to a discharge pipe. The upper cylinders are extended in a telescoping manner to position the rim of the top cylinder to any desired elevation below or above the water surface. As the cylinders are lowered below the water surface, the decant water flows over the weir crest into the interior sections and exits through the discharge pipe in the lower section and returns to the nearby waterway.

The telescoping weir is set within and attached to the base of a reaction frame that provides support for it and the machinery that controls the telescoping movements of the weir. The telescoping weir is raised and lowered by a set of mechanical screw jacks that operate simultaneously either manually or by solar/battery-powered motor. The design can meet a range of water and dredged material storage levels common to most CDF's. The design life of a 12-foot telescoping weir is ten to fifteen years, depending on the rate of filling and consolidation. At the end of the first-term use, the telescoping weir also has potential to be rebuilt and reused.

Conventional weirs have numerous operational disadvantages. One major disadvantage is simply not being able to place or remove the weir boards at the proper time for optimum management of the effluent. The boards' dimensions do not match the required depth of withdrawal and very often leak at the joints. The weirs can present a safety hazard for someone slipping and falling into the weir during removal and placement of the weir boards. Also, it is very difficult to ensure all weir boards are level and at the same elevation; therefore, often 100 percent of the available weir crest is not used. Floating debris at the weir crest causes large withdrawal velocities at greater depths below the weir crest when debris is not prevented from collecting on the weir crest. The weirs also provide a good habitat for snakes, spiders, and wasps.

The innovative telescoping weir has numerous advantages. The principal advantage is being able to provide an infinite elevation adjustment of the weir crest (within the weirs design height) and discharge velocities at the touch of a button. The total crest of the telescoping weirs remains at the same level at all times; therefore, 100 percent of the crest is utilized throughout its use. More efficient, frequent, and friendly use of the telescoping weirs will increase the storage capacity and longevity of CDF's, thus extending the life of a very valuable and expensive storage facility for dredged material containment. The crest of the telescoping weir can easily be lowered to the bottom of the desiccation cracks in the dredged material. This also provides efficient control of surface runoff and enhancement of the desiccation and the drying process. This provided some measure of mosquito control. The telescoping weir reduces labor and cost requirements through the elimination of weir board handling, weir board costs, weir maintenance, and possible weir failure. This greatly provides improved safety, which is another significant advantage. The telescoping weir can also be equipped

with a variety of sensors to measure effluent turbidity, temperature, pH, and biological oxygen demand. If the quality of the discharge effluent were unacceptable, the weir crest would automatically rise to control or stop the discharge. Optional remote readouts and control capability could be used to enable several weirs to be monitored and adjusted from a remote location through a telephone and computer link. The telescoping weir clearly is the best operational device and method to control effluent runoff and management of CDF's. Most significantly, this device and new technology offer a new standard in an area of dredging management that has been very difficult to improve upon for many years.

To date, three full-size telescoping weirs have been installed at the Craney Island CDF in Norfolk, Virginia. The first full-size prototype-telescoping weir was installed in April 1996; the second was installed in June 1998; and the third was installed in April of 1999. The first telescoping weir performed so well, along with two conventional weirs, that the district was able to accommodate a record annual placement of six million cubic yards of maintenance dredged material. Efficient performance of the telescoping weir prevented temporary shutdowns of two very large dredging projects. The first two telescoping weirs have been fully operational and have required zero maintenance to date.

Presently, the Norfolk District is in the process of helping Mobile District install their first telescoping weir. This work should be accomplished by fall this year. The innovative device has high potential to be used throughout the Corps of Engineers, other industrial facilities, and worldwide. Patents for the telescoping weir are being processed with the U.S. Patent Agency and with other foreign countries.

The Dredging Operations and Environmental Research (DOER) Program at ERDC supports the Corps-wide Operation and Maintenance Program. The telescoping weir is being studied, evaluated, and monitored under the DOER innovative technology focus area. This work should further promote the use and will aid in the technology transfer to other interested districts.

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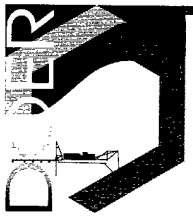
Editor's Note: Reprinted from the July 1999 issue of *Engineering and Constructions News*, Headquarters, Directorate of Civil Works and Directorate of Military Programs, U.S. Army Corps of Engineers, Washington, DC.



Nearshore placement options to be improved through modeling

Jack E. Davis, U.S. Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory

Placing dredged material in open water sites where the material is not confined by structures is common practice. But when placement is considered for nearshore environments, usually only sandy dredged material is allowed because of concerns that fine materials like silts and clays may cause excessive turbidity. Turbidity may affect wildlife use of an area for feeding or spawning and may directly impair the growth of some organisms such as sea grasses or corals. In addition, there is concern that some of the fine materials might find their way onto the beach, thus lessening the beach's appeal to the public. Currently, it is not known whether turbidity generated from a given nearshore mound with significant amounts of fine sediments would cause adverse environmental conditions or whether the fine material would move shoreward. Environmental concerns in the absence of scientific information dictate, therefore, that fine material not be placed nearshore. Currently, even when some dredged materials are mostly sand, if the amount of fine sediments exceeds a specific level, the materials cannot be used for nearshore placement. The benefits lost are that the sand fraction could have become part of the sand supply for the shoreline and the haul distance for the dredged material might have been reduced, thus lowering the dredging cost. The ability to evaluate this type of situation through computer simulations would reveal possible options for dredged material placement in a nearshore environment. The Corps of Engineers has numerical models that aid in predicting the fate of dredged materials as they are placed. The fate of sandy dredged material mounds over long periods, such as months or years, can be simulated by using the model LTFATE, where "LT"

stands for "Long Term." However, when it comes to simulating the behavior of cohesive materials like clays, the model does not work as well as it does for sand because the natural processes are more complicated. A good description of the process of erosion and transport of that material is needed to develop a concise model for simulations.

As part of the Corps' Dredging Operations and Environmental Research (DOER) Program, the Engineer Research and Development Center and Mobile District, constructed a mound of mixed sand and fine-grained sediments offshore of Mobile Bay, Ala., in the fall of 1998. Monitoring was started immediately following construction. Information about waves and current changes in the dredged material mound are being collected.

The purpose of the monitoring is to provide enough data to advance the understanding of the geotechnical properties of dredged material during and after dredging and to provide data to help modify and verify LTFATE. For the environmental reasons given above, it is difficult to find field sites where this problem can be studied. But thanks to the DOER Program, the Mobile District, and permission from the State of Alabama, new technology may be available in the future for simulating sediments that are a mixture of sands, silts, and clays.

Additional information is available from *Jack E. Davis* at the Coastal and Hydraulics Laboratory, Engineer Research and Development Center.

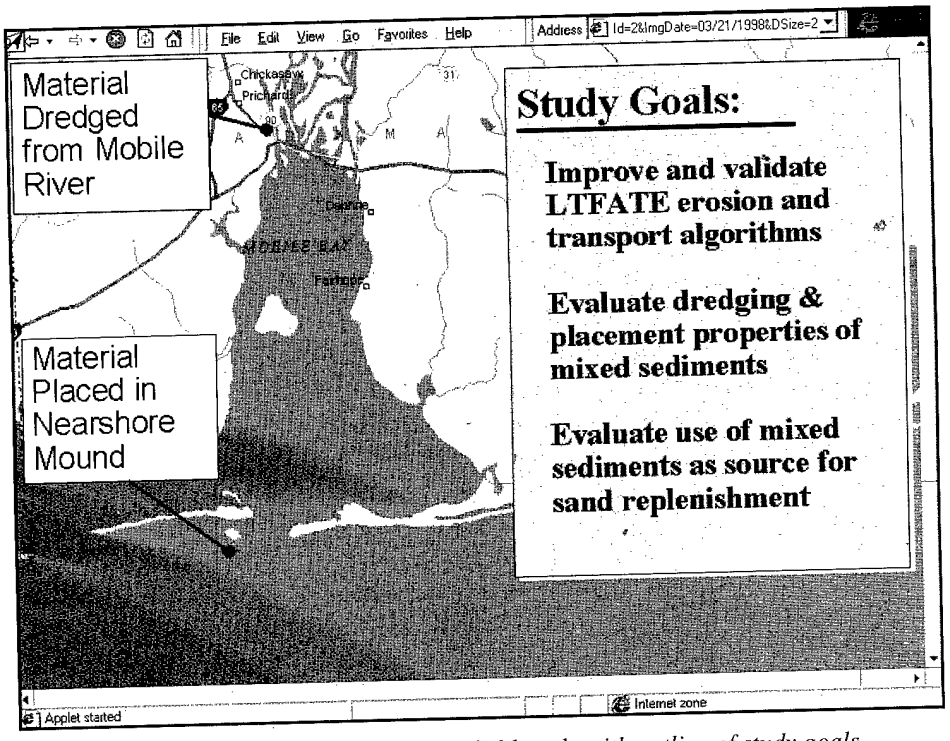


Figure 1. Location of Mobile Bay field study with outline of study goals

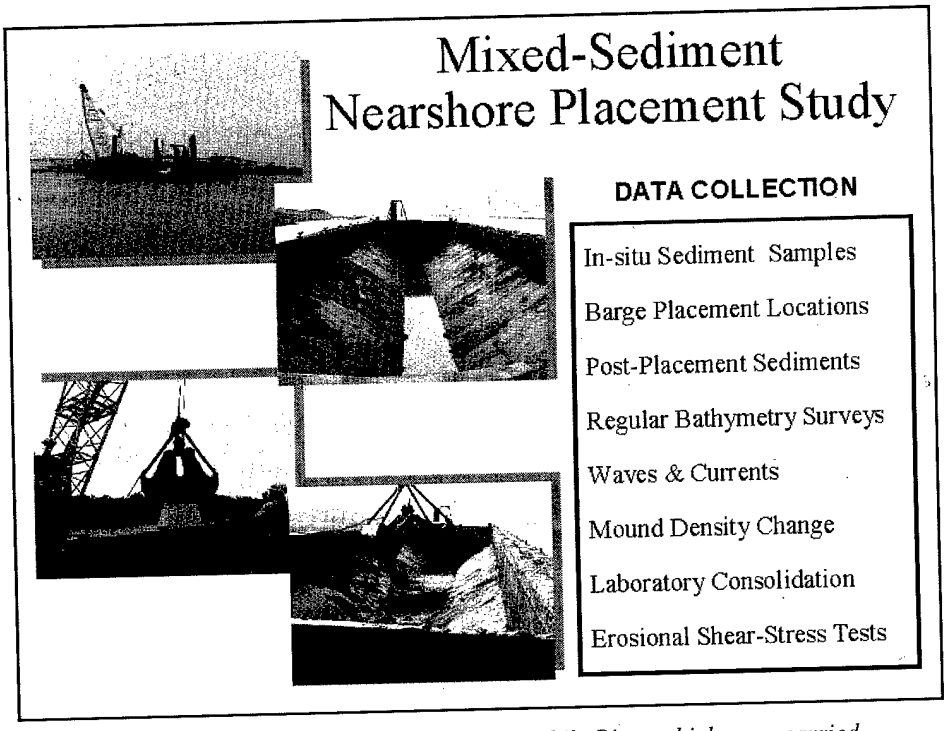


Figure 2. Dredging sediments from the Mobile River which were carried to the offshore field study site for placement. An outline of the data collection effort is included

Dredging Calendar

- 1999 -

October 9-13 - Water Environment Federation Conference & Exposition, in New Orleans, LA.
POC: Water Environment Federation, (800) 666-0206 or *www.wef.org/docs/weftec99.html*

October 20-22 - The Environmental Technology Conference and Exposition, in Atlanta, GA.
POC: *www.aeecenter.org*

November 2-6 - Annual Meeting & Workshop, National Association of Flood and Stormwater Management Agencies (NAFSMA), in Philadelphia, PA.
POC: *www.nafsma.org*

November 8-9 - Missouri River Voyage of Discovery Conference, in St. Charles, MO.
POC: American Rivers, (877) 4-RIVERS or *www.americanrivers.org*

November 12 - Society of American Military Engineers Golf Tournament, Quarry Golf Course, in San Antonio, TX.
POC: Michael Redfern, (210) 652-3240 (DSN 487-3240)

November 16-17 - Wetlands and Remediation: An International Conference, sponsored by Battelle, in Salt Lake City, UT.
POC: *nehringk@battelle.org*

November 30-December 2 - Partners in Environmental Technology Symposium, sponsored by the Strategic Environmental Research and Development Program (SERDP) and the Environmental Security Technology Certification Program (ESTCP).
POC: Jenny Rusk, (703) 736-4548 or *jrusk@hgl.com*

December 5-9 - Symposium on Water Resources and the World Wide Web, in conjunction with the Annual Meeting of the American Water Resources Association, in Seattle, WA.
POC: *www.awra.org/meetings/Seattle99/*

- 2000 -

January 11-13 - The Dredged Material Assessment and Management Seminar, sponsored by EPA and U.S. Army Corps of Engineers, in San Diego, CA.
POC: Ms. Billie Skinner, FAX (601) 634-3528 or *skinneb@wes.army.mil* or registration online: *www.wes.army.mil/el/dots/training/register.html*

News Briefs

Dredging Research to continue in print beyond Oct. 1, 1999

Although the U.S. Army Corps of Engineers is an exclusively electronic publisher effective with the new fiscal year, the information exchange bulletin *Dredging Research* will continue to be available in paper copy to those who wish to stay on the distribution list. Since the electronic copy is in full color and available up to 45 days earlier than the printed copy, subscribers may notify the editor at any time to be deleted from the mailing list for the printed copy. Contact information can be found on the back page of the bulletin. Including the shipping label number on a change request is helpful. Upon request, an e-mail notice announcing the new online issue can be sent.

New e-mail system requires change in e-mail addresses

E-mail addresses for personnel at the laboratories located at the Waterways Experiment Station have changed from *....@ex1.wes.army.mil* or *...@mail.wes.army.mil* to *...@wes.army.mil*. With the formation of the new Engineer Research and Development Center, addresses for mail and URLs for websites under the ERDC may again change. Every effort will be made to use technology to the advantage in making the transition an easy one. Watch for announcements on the What's New page of the Environmental Laboratory website.

Early bird registration for Seminar 2000 still possible until Nov. 18

The joint EPA and Corps Dredged Material Assessment and Management Seminar will commence Jan. 11-13, 2000, in San Diego's Westin Horton Plaza Hotel. Information and online registration opportunity is available from the DOTS website at *http://www.wes.army.mil/el/dots/training.html*. The seminar has a registration fee of $50, and Government rate is available for eligible registrants.

Articles for *Dredging Research* requested

Dredging Research is an information exchange bulletin for publication of ERDC-generated dredging research results. Included are articles about applied research projects. The bulletin serves all audiences and is accessible on the World Wide Web in addition to a paper circulation of 2,800.

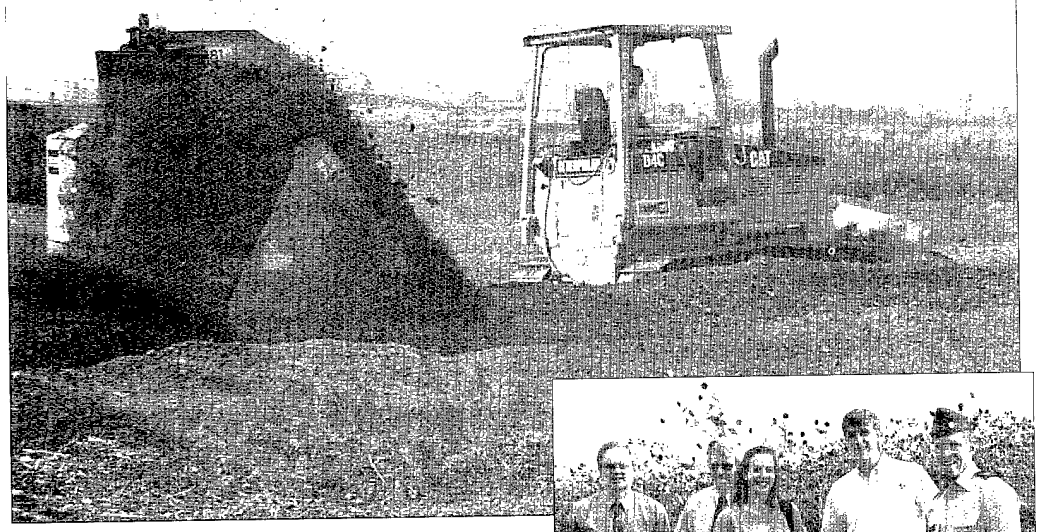
Articles from non-ERDC authors are solicited for publication, especially if the work described is tied to the use of ERDC-generated research results. Research articles that complement ERDC research or cover wide field applications are also accepted for consideration. Manuscripts should include suggestions for visuals and a brief biography of the author and should use a nontechnical writing style. Point of contact is Elke Briuer, APR, at *briuere@wes.army.mil*.

Dredged material compost demonstration at Jones Island CDF highlights Visitors' Day, showcases multi-agency project

More than 30 representatives of Federal, state, and local governments; universities; and industry attended Visitors' Day activities at the Jones Island confined disposal facility (CDF), Milwaukee, WI, Sept. 23, 1999. Activities included presentations by Corps of Engineers, Environmental Protection Agency, State of Wisconsin Department of Natural Resources, and academia on the feasibility of dredged material decontamination using composting technology and a tour of the compost demonstration project. "Visitors' Day is an opportunity for us to showcase one of our projects and for us to thank our partners for their participation," said COL Robert J. Davis, District Engineer, Detroit District. Partners for the Milwaukee project (and a similar compost demonstration at Green Bay, WI) include

- The Environmental Protection Agency's Great Lakes National Program Office (GLNPO),
- The Dredging Operations and Environmental Research (DOER) Program,
- The Milwaukee Port Authority,
- The Brown County Port Authority (Green Bay project),
- The University of Wisconsin-Milwaukee Center for By-products Utilization,
- American Foods Industries (Green Bay project),
- The Milwaukee Metropolitan Sewerage District, and
- The U.S. Army Engineer District, Detroit

The composting process involves mixing dredged material with biosolids, such as sewage sludge or manure, and wood chips in windrows and periodically turning the windrows to aerate. The objective is to biodegrade organic contaminants such as polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) in the dredged material so that the material can be used beneficially. Removal of noncontaminated dredged material in the CDF will provide space in the CDF for future use, avoiding the cost of new CDF construction.



Windrow turning at the Milwaukee Confined Disposal Facility during Visitors' Day activities

Visitors' Day at Jones Island CDF: Left to Right: Dave Bowman, Environmental Scientist and Detroit District Project Manager; Dr. Tommy Myers, DOER Principal Investigator; Linda Scorn, Environmental Engineer, Chicago District; Scott Cieniawski, Environmental Engineer and GLNPO Project Manager; and COL Peter Rowan, District Engineer, Chicago District.